

ABSTRACT

5 A new photopolymerizable material allows single-step, fast recording of volume
holograms with properties that can be electrically controlled. Polymer-dispersed liquid
crystals (PDLCs) in accordance with the invention preferably comprise a homogeneous
mixture of a nematic liquid crystal and a multifunctional pentaacrylate monomer in
combination with photoinitiator, coinitiator and cross-linking agent. Optionally, a
surfactant such as octanoic acid may also be added. The PDLC material is exposed to
10 coherent light to produce an interference pattern inside the material. Photopolymerization
of the new PDLC material produces a hologram of clearly separated liquid crystal
domains and cured polymer domains. Volume transmission gratings made with the new
PDLC material can be electrically switched between nearly 100% diffraction efficiency
and nearly 0% diffraction efficiency. By increasing the frequency of the switching
15 voltage, switching voltages in the range of 50 Vrms can be achieved. The optional use of
a surfactant allows low switching voltages at lower frequencies than without a surfactant.
In an alternative embodiment, a PDLC material in accordance with the invention can be
utilized to form reflection gratings, including switchable reflection gratings. In still
further embodiments, a PDLC material in accordance with the invention can be used to
20 form switchable subwavelength gratings. By further processing, static transmission,
reflection, and subwavelength PDLC materials can be formed. In addition, PDLC
materials in accordance with the present invention can be used to form switchable slanted
transmission gratings suitable for switchable optical coupling and reconfigurable optical
interconnects.